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What can the specialist in physiology do without some knowledge of physics and chemistry? Geology, zoology and botany are hedged with problems whose solution are interdependent. If the sciences are united as with a network, a specialist in any one of them must have some knowledge of those which claim near kinship with his own.

But the specialist is accused of couching his discoveries in language which is unintelligible, of being impractical; of trying as it were to hide his light under a bushel. Are these accusations well-founded? Are they true? Is it reasonable to suppose that one who studies in nature's laboratories a lifetime should think it desirable to erect a wall about science lest it become popular? Are not specialists numbered among the world's great leaders? To whom is due the great advancement in medical science but to specialists, who in their laboratories patiently sought for answers to problems of whose importance the common mind has no conception? A few years ago a war of words waged high over the theory of spontaneous generation; who but the specialist was able to settle forever this formidable question. Did the world imagine for one moment that the investigations which resulted in the establishment of the "germ theory" would lead to practical results? Physicians, surgeons and boards of health but apply the principles elucidated by the specialist. Enter a laboratory and behold a specialist in the midst of his bacteriological investigations. Would the observation be likely to call forth predictions of practical results? You would see "cultures" under bell-jars, microscopes, and various apparatus; "but," you exclaim, "what bearing do they have on human welfare?" Under the supervision of the bacteriologist they touch the very heart of humanity, bidding it look to its drains and sewers, to its drinking water, to the air it breathes and the purity of its food. Our knowledge of disinfection comes from the same source; who can measure the practical results? Practical applications of investigations in *fungi* reach out to the horticulturist and the farmer, who anxiously look to the specialist for remedies against their microscopic enemies. When the results of the investigations of specialists radiate like the rays of the sun to all humanity, offering balm for its wounds, remedies for its ills, shall they themselves be deemed impractical, having no concern for human welfare? When they stand face to face with nature and read the histories she has written on shell and stone, on land and sea; when they recognize the bond of union in the division of labor, shall they be charged with "deliberately planned mystification" of the truths they would gladly sow broadcast over the land? Specialization is a law of nature which is stamped on every blade of grass, and on every flower that blooms. Heredity emphasizes this law in every phase and form of life. If it were not so, no individuality would exist. The oak tree does not take upon itself the production of roses, apples or grapes, nor does the rose ever dream of producing acorns or of elaborating material which will ultimately form an oak tree. Each individual cell in every plant contributes to the building up of its own special tissue.

Suppose we take the musical notes of some grand symphony, and scatter them at random on the musical staff; rendition would create but jarring discords. Let a Mozart or a Beethoven place each note where it belongs, and the resulting harmony "wakens in the soul a feeling earthly speech can ne'er declare." May not mankind be compared to these musical notes, creating discord in society because the individuals are not so placed as to enable them to gratify their best and highest aspirations, to do their special work?

Is it utopian to hope that each individual, like each note in a musical conception, may some day swell the grand choral of the universe?

MRS. W. A. KELLERMAN.

Columbus, O.

ON A RECENT DISCOVERY OF THE REMAINS OF EXTINCT BIRDS IN NEW ZEALAND.¹

A DEPOSIT of moa bones, larger than has been found for many years, has just been discovered near the town of Oamaru, in the province of Otago, in the South Island of this colony. Their presence was indicated by the disinterring of a bone during the ploughing of a field, by the proprietor of which the circumstance was communicated to Dr. H. de Lautour of Oamaru. This gentleman, who is well known through his papers on the diatomaceous deposits discovered by him in his district, at once inspected the spot. Finding that the deposit was large, he first secured, through the kindness of the proprietor, the inviolability of the ground, and then telegraphed the information to the Canterbury Museum. I lost no time in proceeding to Oamaru with one of my assistants, and superintended the digging out of the bones in a systematic manner. The site of the deposit was at Enfield, some ten miles to the north-west of the town, on ground elevated several hundred feet above the level of the sea, in a shallow bayleted hollow, into which the unbroken surface of the expansive slope gently descending from the Kurow hills to the open vale of the Waireka (a stream that rises further to the west) has sunk here for some seven to eight feet below the general level, and which, proceeding with a gentle gradient valleywards, becomes a ditch-like conduit for a tributary of the Waireka. In the centre of this depression, which does not exceed ten or twelve yards in width, the ground was of a dark brown color, damp and peaty. On removing the upper layer of soil for a depth of three to four inches round where the bones had first been brought to the surface, and whereon was strewn abundance of small crop-stones, a bed of very solid peat was reached, and firmly imbedded in it were seen the extremities of numerous *Dinornis* bones, most of them in excellent preservation, though dyed almost black. Further digging showed that certainly many of the skeletons were complete, and had been but slightly, if at all, disturbed since the birds had decayed. Owing, however, to the close manner in which they were packed together, and especially in which the limbs were intertwined, it was rarely possible to extricate the bones in the order of their relations, or to identify with certainty the various bones of the same skeleton, each bone having to be extracted as the circumstances of the moment directed. In many cases, again, only the pelvis and femora could be traced *in situ*, the vertebræ and remaining leg-bones being indistinguishable in the general agglomeration. It seemed evident that the birds had not died in an erect posture, but more probably with their limbs bent under them or in the same plane with the body. In some instances, beneath the sternum were found, lying quite undisturbed, the contents of the stomach, consisting of more or less triturated grass mingled with crop-stones. The quantity of these smooth, rounded (chiefly white quartz) pebbles — in size from that of a bean to that of a plum — mingled with the bones was enormous, and would, if collected, have formed more than a cart-load. Except where the bones were, there were no pebbles of any sort, no small stones, nor even sand, anywhere around. The nearest place where pebbles of the same composition are to be found is, I was informed, several miles distant.

¹ From Nature.

Four trenches, or pits, in all, were sunk. The dimensions of the first, which was excavated entirely in peat, did not exceed three feet square and three and a half to four feet in depth. When it was exhausted of its treasure, a second search was made about twenty to twenty-five feet higher up the hollow. The dimensions of this pit extended to about seven feet square and to the same depth as the first. Two more trenches, a few feet apart, were dug at about thirty yards still further up the depression. They were not so large as the other two, but they extended down to about the same depth, three and a half to four feet, the bottom of both being (as it was in the second) a bluish clay, with which, in the pit furthest up, was sparingly mingled a small deposit of the finest silt. In the first pit portions of both *Cnemiornis* and *Hæpagornis* bones were found in abundance, and remains of several hundreds of moas of all ages. It was from the second pit, however, that the largest deposit of moa bones was obtained, and the most perfect specimen of food remains from beneath a sternum. Here, also, numerous bones of the giant buzzard and of the great extinct goose were exhumed, and a cranium as large as, if not slightly larger than, that of *Cnemiornis*, but of a species with complete bony orbits, as in the Cape Barren goose, and indistinguishable from *Cereopsis*. Bones from other parts of New Zealand now in my possession, which I hope shortly to describe, indicate with certainty that several species of *Cnemiornis* formerly existed in this colony. Some of these bones are remarkable for their slender elegance, and indicate species less in size and lighter in build than *Cnemiornis calcitrans*. Among the bones so far examined, I have observed no remains of *Aptornis*, of *Ocydromus*, or of *Notornis*; but I possess an adult tibia of a rail smaller than *Porphyrio melanotus*, yet larger than any other existing New Zealand species. The tarso-metatarsus of a species of *Anas*, about the size of *Anas finschi*, the metatarsus and sternum of *Apteryx Oweni*, and crania of *A. australis*, are among the bones recovered at Enfield, in addition to the metatarsus of a *Biziura*, somewhat larger than *Biziura lobata*, the musk duck of Australia, an interesting species for which I have proposed the name of *Biziura de Lautouri*, after the gentleman to whom I am indebted for the acquisition of these bones. There are still other bones which I have not yet been able to identify. The *Dinornis* remains belong chiefly to the species *elephantopus* (of unusually large proportions), to *ingens*, and to *rheides*. Very fine specimens of pelvis and sterna have been obtained, with numerous crania more or less perfect. In this second trench the excavation penetrated through the peat into a bluish clay charged with water (which was, indeed, reached in all the diggings at about four feet below the surface), and into this clay the bones just protruded, but no more. The osseous remains dug from the last two holes belonged to the same species as those from the others. Digging and probing the ground beyond the boundaries of the trenches showed us that we had exhausted their contents; while the probing of the ground in the neighborhood for a considerable radius around, and in other peaty spots not far off, failed to afford indications of other deposits.

The number of perfect femora of *Dinornis* brought away exceeded 600; a large number were so decomposed as to fall to pieces in the handling; while a great many others disintegrated, after removal from the ground, on exposure to the atmosphere. I believe I do not over-estimate, therefore, in saying that from 800 to 900 moas at least were entombed in this shallow hollow. So many moas (leaving out of the reckoning the other species of birds) could not by any possi-

bility have found standing-room, however crowded together, in the entire area of the depression. It would appear evident, therefore, that they did not perish all at one time. To account for their burial in such numbers in areas so circumscribed seems to me at present impossible. That their bodies were entire when they were deposited is clear, from the presence in such abundance of the crop-stones, from the position of the bones, and from the finding of the intact contents of the gizzard. No stream of any size could find origin in the immediate neighborhood, and no stream which could have transported the entire carcasses of birds of such huge proportions as *Dinornis ingens* or *D. elephantopus* could ever have occupied this ravine-head without leaving traces of its action on the surface which would be visible to-day, or without washing away the very fine silt mixed with the clay on which the bones lie, in the bottom of the most upland of our excavations. None of the bones are waterworn. This little hollow was, in the early days of its present proprietor, very wet and boggy, and several springs have origin in it. If the moas made this a highway from one part of the country to another, it seems difficult to believe that birds so powerful of limb, and standing at least 10 to 12 feet in height, could stick fast in so shallow a bog; and to conjecture why eagles of powerful flight, slender rails, small ducks, and comparatively light-footed kiwis also should become ensnared. Driven by fire in the surrounding bush — which may have covered the country then, for the plough has, I am informed, brought to light the stools of many large trees at no great distance, while logs of wood were found among the bones — did they, in a struggle for life in a narrow space, trample each other to death? The presence of the strong-winged *Harpagornis* in considerable numbers seems to militate against this explanation, and no calcined bones have been discovered. An explanation offered some years ago, to account for the presence of a great number of moa and other bird bones in a somewhat similar situation in the Hamilton swamp — that during severe winters these birds congregated at the springs rising warmer from below, and were overtaken by a severe and fatal frost as they stood in the water — appears unsatisfactory in the present case, as there are numerous springs and equally boggy ground near at hand, round which no remains can be found, and so close to the sea such excessive frosts are now unknown. That these were individuals who, during an excessive drought, arrived at the springs too far exhausted to revive — an occurrence common enough in Australia — and that the water there was charged with poison, have also been offered as explanations. But the permanence of glacier rivers, highest in the hottest seasons, precludes the idea of animals dying of thirst in this island, or at all events in this locality so near to the great snow river Waitaki. Poisoned water-holes or exhalations of carbonic acid might be a sufficient reason, yet in those springs elsewhere where bones have been found chemical analysis has failed to detect any substance harmful to life in their waters at the present day. Not a single indication of human intervention was observed. No bones were discovered which had been broken in their recent state; neither kitchen-middens, nor remains of ovens or of native encampments, occur anywhere near the deposit.

One piece of egg-shell dug out of the highest trench is not sufficient evidence on which to base the supposition that the spot was frequented as a nesting-place.

At Glenmark, in the north of this province, the historic spot where the original (somewhat larger than the present) find of *Dinornis reliquiae* was dug out by my predecessor,

the late Sir Julius von Haast, the bones of numerous species of birds besides moas were found. Their occurrence in the situations where they were discovered, and the way in which they were lying—entire bodies with their sterna covering crop-stones *in situ*—have been explained by the supposition that the moas were overtaken by a fierce and sudden storm, and their entire carcasses piled by wind and flood into vast heaps, an explanation against which the presence here also of the same powerful buzzard and other flying birds rises as an objection. Yet there is nothing either in the situation or the disposition of the bones to make it impossible; still I cannot help feeling that that cannot be the true explanation which satisfies only one instance out of so many assemblages of dead birds of nearly always the same species in situations almost similar. I hope, however, that when I have made a thorough examination of all the localities where, and the conditions under which, moa remains have been found, in the light of the personal experience gained in the exhumation of the present deposit, and when I have completed the identification (on which I am now engaged) of the smaller bird bones associated in them with the moa bones, some light may have been gained on this at present mysterious episode in the history of the ancient Avians of New Zealand.

HENRY O. FORBES.

Christchurch, New Zealand.

LETTERS TO THE EDITOR.

****.** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Need of Physiology and Anatomy in Psychological Training.

IN a recent article in *Science*, by Dr. E. W. Scripture of Clark University, some valuable and practical ideas are advanced concerning "the need of psychological training," in which the necessity of a practical knowledge of physics is made clear. But no less necessary is a like knowledge of physiology and anatomy.

Physiological psychology is no misnomer for modern psychology, because it is as much if not more physiological than psychological. That, consequently, a somewhat extensive knowledge of physiology is a *sine qua non* for the thoroughly trained modern psychologist goes without saying; and this is as true whether there be sympathy or not with the modern view, for, in the latter case, the psychologist can hardly avoid discussing some of the results of physiology; and such discussions, to be trustworthy and valuable, must be based upon knowledge. And here is not meant mere book knowledge, but experimental knowledge gained in the physiological laboratory, otherwise when one speaks of sensations, reflex action, afferent and efferent nerves, etc., it is difficult to understand how he can have any adequate insight into the objective reality of these phenomena. It is not intended that any large amount of time be required for purely physiological laboratory work. A term's course, say of six hours a week, might be the minimum; in this case it is assumed that the student has a general knowledge of human and comparative physiology.

If the above requirements are necessary for one who proposes to study physio-psychological questions, it may be inquired further as to anatomical knowledge. That a proper conception of physiology is not possible without anatomy is so obvious as to be commonplace, and yet there are some who are serious students of physiological psychology who have no practical knowledge of anatomy. A general dissection of the body and special dissection of the sense-organs and brain, while it would require more time than the physiological course, would be well worth the extra

trouble, since it is preliminary foundation-work, and is also necessary for the investigation of pathological clinical cases, some of which are of the highest importance for the physiological psychologist. For this and other reasons an elementary course in practical histology is necessary. Thus it is not clear how any student without practical knowledge of coarser and finer anatomy can study and discuss intelligently questions concerning cerebral localization, cranial and spinal nerves, spinal column, medulla oblongata, etc.

It may be objected that many of the facts learned in such a course of study would not be of direct utility, but this could be urged against almost any course of study. The value of such negative knowledge consists in serving as a sort of ballast in aiding the student in avoiding mistakes.

It may be said that if practical courses in anatomy and histology are requisites, why not also similar courses in pathology and psychiatry. It is true that these would be valuable; but there must be a limit; perhaps the student could take up individual pathological cases as they came in the course of his work, provided he has the physiological and anatomical knowledge of normal man before mentioned. It is assumed that the specialist in physiological psychology will read the writings of specialists in physiology, anatomy, and pathology when they treat of topics that bear directly on his own studies. To read such literature, appreciate the points of discussion, and make decisions as to weight of evidence, requires at least a practical elementary knowledge of the subjects.

But it may be objected that, with accurate book learning and good diagrams, one can gain sufficient insight without going to the trouble of taking the practical courses. This objection is more real practically than rationally, for many do not care for vivisection, and much less dissection. It is a well-known difficulty, common to medical schools, to obtain faithfulness in dissection. There seems to be a natural disinclination, not of the nature of dread or disgust that may appear on first entering the dissecting room, but quite another feeling, that is easier experienced than described. The physiological psychologist who has had no medical training is very liable to have a strong disinclination to practical work in anatomy, even if he believes in its utility and necessity. Then there is sometimes the feeling that it is so much easier and saves time to sit quietly in one's own room and study the books and diagrams.

It may be said that some good workers in physiological psychology have never had this preliminary training, but this is rather in spite of such training. As is well-known, many students of philosophy, having become dissatisfied with its methods and results, have turned their attention to experimental psychology, and have neither time nor opportunity to return to preliminary work, which they could have done had they known beforehand the subsequent direction of their studies.

The fact that the majority of leaders in the department of physiological psychology were previously physicians or students of medicine indicates the direction which the training in physiological psychology should take.

A. MACDONALD.

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Anthropology.

THE science of anthropology has so far progressed that it is desirable to keep a satisfactory account not only of its operations but of its resources. Under this head should be included: 1. Encyclopædic works, general treatises, annual addresses, courses of lectures, dictionaries, general discussions, and classifications of the science as a whole. 2. Societies, their organization, scope, history, enterprises, and publications, as well as annual assemblies, caucuses, congresses, national and international. 3. Periodicals, devoted as a whole or in part to anthropology. 4. Museums and laboratories, public and private, expositions and loan exhibitions. 5. Libraries, galleries, portfolios, etc., including instructions to collectors.

At this time it is desirable to know what is doing in each State along the line of anthropology. We all know pretty well the work doing in Massachusetts; but where should we look for the